Space Weather Technical Forecast

Issued on Monday, 13 March 2023 at 13:39 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Geomagnetic Storm intervals from late on day 2 (14th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with only isolated C-flares. Peak flare was a C3.1 at 13/1105 UTC from a filament eruption near centre disc in the northern hemisphere. There are currently eight numbered sunspot regions on the visible disc, with AR3253 recently decaying to plage and AR3239 and AR3241 rotating round the northwest limb to the far side during the period. Most of the regions on the disc are unipolar and have shown little change, with AR3245 (Hhx/Alpha) in the southwest the largest region on the disc. AR3250 (Cro/Beta), near centre disc, is presently the only bipolar region, however it is small, magnetically simple and has shown signs of decay during the period.
A filament eruption was observed on the southeast disc later on the 12th, with an associated ribbon-separation evident in H-alpha GONG and SDO imagery. This produced a CME which has been observed in imagery off the south-centre disc. This CME has been analysed and may produce a glancing blow at Earth later on the 15th into the 16th. Any CME associated with the filament eruption mentioned above at 13/1105 UTC will need to be analysed as imagery becomes available to determine whether it is Earth directed, but it is possible due to the location of the eruption.
At 13/0336 UTC a fast full halo CME can be seen emerging on coronagraph imagery. This event has been determined as far sided and not Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind has been slow during the past 24 hours, ranging between 320 and 380 Km/s. The density has been average (5-10 ppcc). The total IMF strength was weak (<6 nT), with the north-south component mainly positive, ranging between -1 and + 5nT. The Phi angle was mainly negative (towards the Sun), but transitioned to positive towards the end of the period. Geomagnetic activity was Quiet to Unsettled (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 increased from 13/0500 UTC in response to the large far sided CME, reaching S1 minor storm levels, with a peak of 14 pfu at 13/0910 UTC. It has subsequently declined to slightly elevated levels. The greater than 100 MeV also increased to slightly elevated level.
The high energy electron flux (greater than 2MeV) has been at moderate to background levels, with a peak of 435pfu at 12/1710 UTC. The associated 24 hour Electron fluence has remained below Active and declining. At 13/0000UTC the observed fluence was 1.36e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is generally expected to be Low or Very Low, with isolated C-class flares. There is a very slight chance of M-flares.

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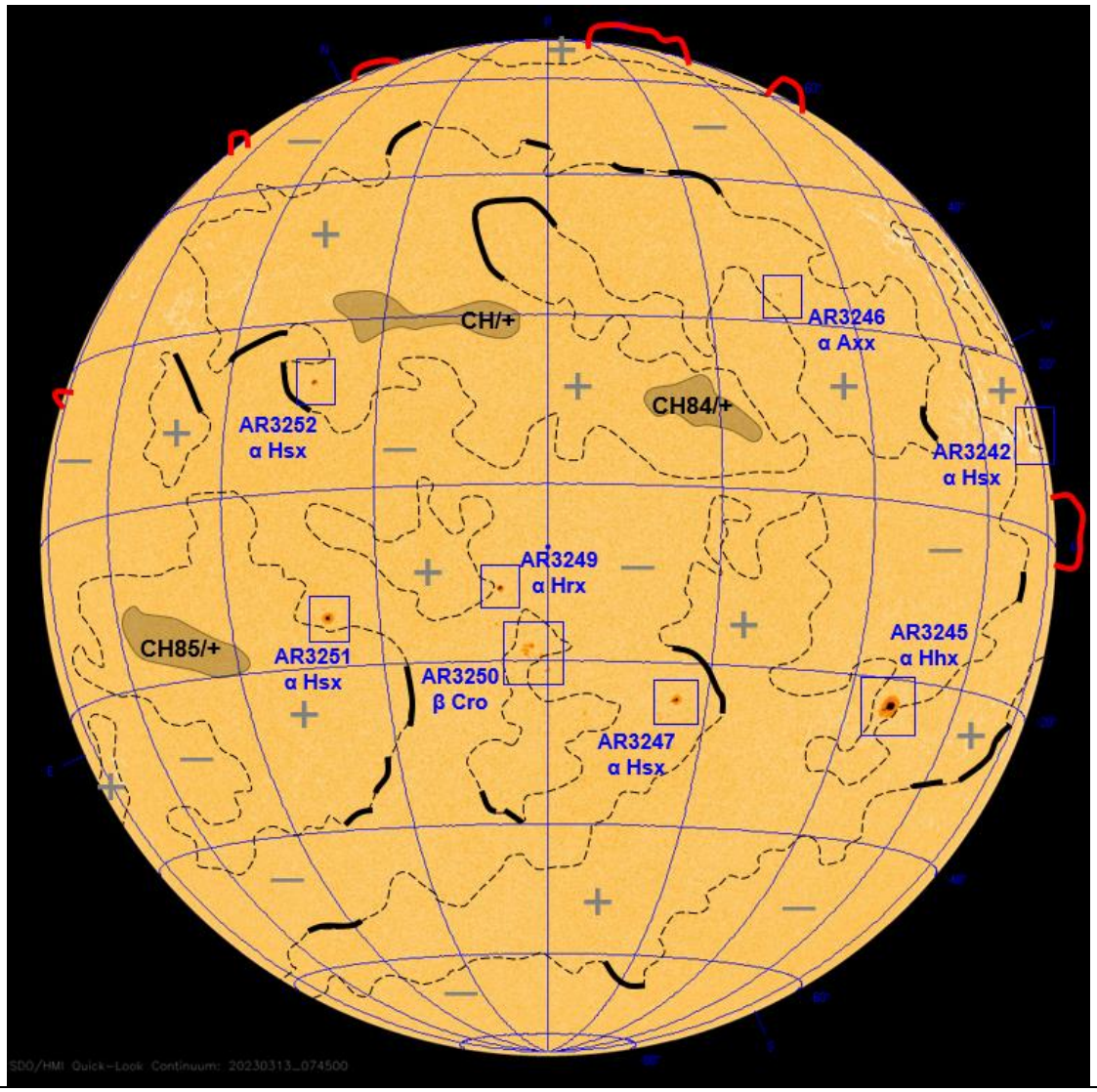
Solar Wind / Geomagnetic Activity: Glancing CME impacts are possible from late on day 2 (14th) due to two filament eruptions that occurred on the 10th and 12th. Otherwise, slow solar winds are likely to become slightly elevated on day 3 (15th) due to the arrival of fast winds from CH84/+.
Geomagnetic activity is likely to be mostly Quiet with isolated Unsettled intervals (Kp 0-3) on days 1 and 2 (13th and 14th), increasing to Unsettled, with occasional Active intervals by Day 3 (15th). There is a slight chance of G1/Minor Geomagnetic storm intervals from late on day 2 (14th) due to the possible glancing CME impacts.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is currently slightly elevated, but expected to decline to background levels. High energy electron flux levels (greater than 2MeV) are expected to be at Background to Moderate, with the associated 24 hour fluence expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 13/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME associated with a filament eruption off the southwest quadrant on the 10th may pass close enough to Earth to give some glancing influence late on day 2 (14th) into day 3 (15th). A further filament eruption from the southeast disc on the 12th has also produced an associated CME, which may glance Earth late on day 3 (15th) into day 4 (16th). Confidence in the impacts from these events is low.
Otherwise Earth is expected to remain within a slow wind environment with mainly background speeds on days 1 and day 2 (13th and 14th). A transition into enhanced wind environment is then expected day 3 (15th) due to the arrival of the high speed stream (HSS) of CH84/+. MOSWOC Enlil is currently considered a good guide to expected conditions, with any enhancement relatively muted. This gives a peak of slightly elevated solar winds at around 400-500 km/s.
Geomagnetic activity is likely to be mostly Quiet with isolated Unsettled intervals (Kp 0-3) on days 1 and 2 (13th and 14th), increasing to Unsettled, with occasional Active intervals by Day 3 (15th). There is a slight chance of G1/Minor Geomagnetic storm intervals from late on day 2 (14th) due to the possible glancing impacts from the CMEs mentioned above.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
10/1600	Partial	Filament	SW disc	410 km/s	Missing	Glance possible late 14th/15th
12/11740	Partial	Filament	S disc	760 km/s	Missing	Glance possible late 15th/16th

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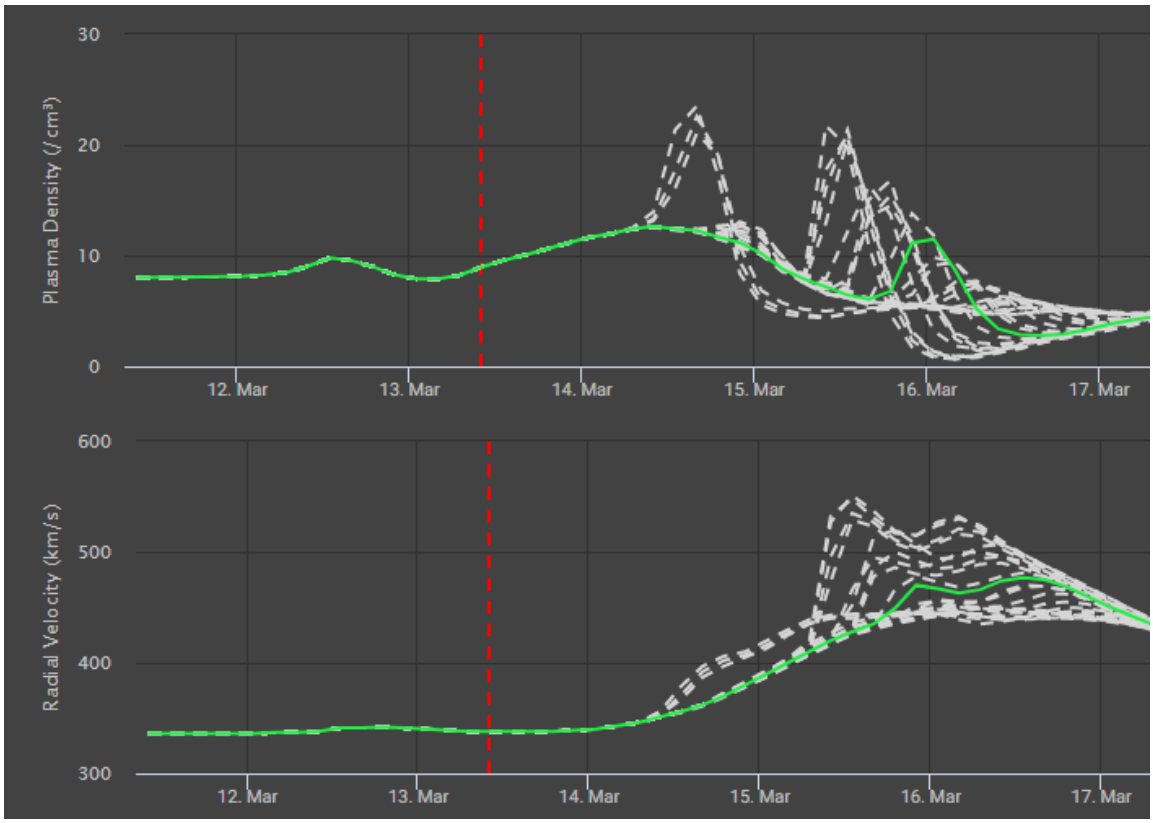
Figure 2: ENLIL Ensemble



Radio Blackouts - X-Ray Flares:

Very Low to Low solar activity is expected, with only a very slight chance of M-flares. There are currently eight numbered sunspot regions on the visible disc, Most of the regions on the disc are unipolar and stable. AR3250, near centre disc, is the only bipolar region, however it is small, magnetically simple and appears to be fading.
The most likely source of any activity would potentially be from any filament lifts that occur, with a number of these features across the Earth-facing disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

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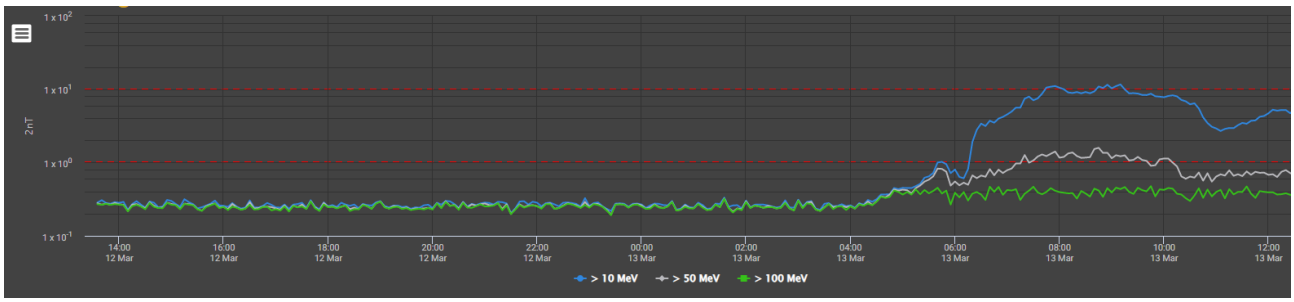
Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, are currently declining towards background levels. They are expected to remain at this level throughout the period, given the lack of significant active regions currently on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: GOES 16 Proton Flux



High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux at GEO, as observed by GOES-16, is expected to persist at Background to Moderate levels. The arrival of fast winds from CH84/+ or any CME is likely to drop electron fluxed further, to mainly background. With only a weak connection to these features anticipated, flux levels are likely to then persist at mainly background, perhaps rising to Moderate by the end of the period.
The associated 24 hour electron fluence is expected persist at below the Active level and likely declining. REFM is currently giving a good guide to expected conditions before any enhanced wind environment from CH84/+ or potential CME.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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